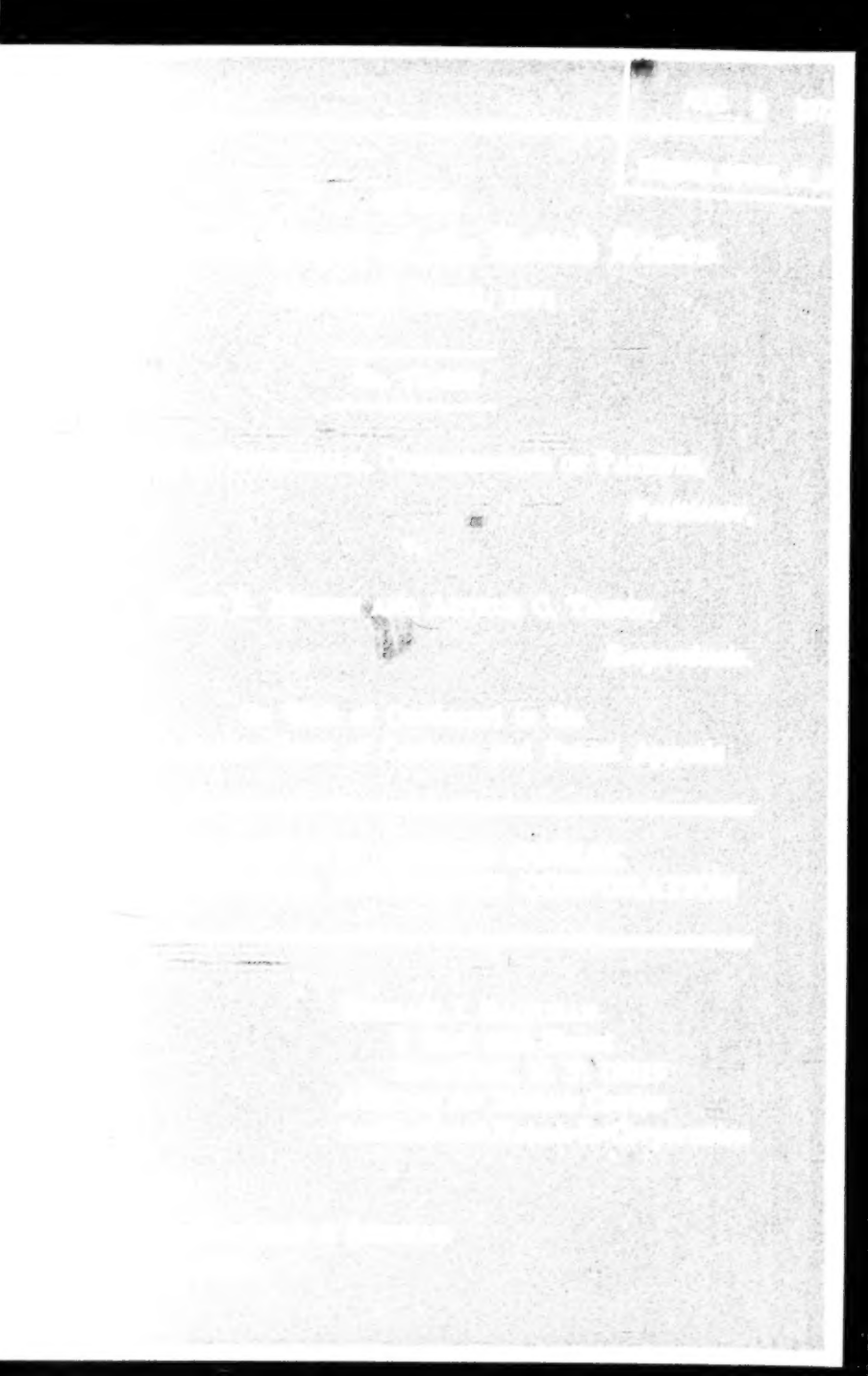

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IN THE

Supreme Court of the United States

October Term, 1971

No. 71-485

ROBERT GOTTSCHALK, COMMISSIONER OF PATENTS,

Petitioner,

v.

GARY R. BENSON AND ARTHUR C. TABBOT,

Respondents.

On Writ of Certiorari to the
United States Court of Customs and Patent Appeals

BRIEF FOR AMICUS CURIAE INSTITUTIONAL NETWORKS CORPORATION

Institutional Networks Corporation ("Instinet") submits this brief *amicus curiae* with the written consent of both parties to the case. The letters of consent have been filed with the Clerk of the Court.

QUESTION PRESENTED

Under the Constitutionally-based definition of patentable subject matter in the Patent Act, is there any basis for distinguishing between a method of numerical conversion carried out by an electronic machine having a fixed control sequence (a type of machine sequence traditionally recognized as being within the statutory classes of invention) and the same method carried out by a computer having a programmed control sequence?

INTEREST OF AMICUS CURIAE

Instinet furnishes a service which allows institutional investors to buy and sell stocks automatically and anonymously. To this end, all subscribing institutions are provided with television-type displays and keyboards which are connected over leased telephone lines to a shared central computer. A substantial portion of Instinet's investment is embodied in its communication system, its terminal designs and the programming of its computer, and certain aspects of the Instinet system are disclosed and claimed in its U.S. Patent No. 3,573,747. If in the present case the Court establishes that patent protection for any invention involving programming is precluded as a matter of law, then the validity of Instinet's patent may be jeopardized and Instinet may be at a competitive disadvantage relative to larger companies who will be in a position to copy its invention and offer the same service.

CONSTITUTIONAL AND STATUTORY PROVISIONS INVOLVED

Article I, Section 8, Clause 8, of the Constitution of the United States provides:

> The Congress shall have Power . . .
>
> • • • • •
>
> To promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries.

35 U.S.C. § 100(b) provides:

> The term "process" means process, art or method, and includes a new use of a known process, machine, manufacture, composition of matter, or material.

35 U.S.C. § 101 provides:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

INTRODUCTION AND SUMMARY

The "questions presented" by the petitioner and the *amici* which support its position are limited to the patentability of a method, under programmed control, for converting numerical information from one form to another. But their briefs deal with the much broader question of whether computer programming methods in general are patentable. The record before the Court is incomplete with respect to the nature of computers and programs, and it is respectfully urged that even should this Court rule in favor of petitioner, the holding should not be extended to the much broader issue which has improperly materialized. Of necessity, however, we will direct our argument to both the narrow and the broad issues.

A fixed control machine is one whose basic method of operation cannot be varied without making wiring changes or replacing parts.

A programmed control machine (a general-purpose computer) is one whose basic method of operation can be

varied without making wiring changes or replacing parts; but to vary its basic method of operation still requires that numerous physical changes be made. That is because a general-purpose computer is a machine having a very large number of component parts which, prior to the machine's being programmed, do not cooperate with each other to produce any useful result. In order to apply the machine to some useful end, it must be programmed. The programming of a computer causes physical changes in the individual parts, and a new inter-relationship to be formed among them. By programming a computer, the user creates a new machine.

There is no dispute that methods of operating machines under fixed control are patentable, even if the methods are based upon mathematical relationships. Because methods of operating machines under fixed and programmed control are fundamentally the same, the latter should be entitled to the same protection.

A written list of program instructions is not in itself patentable subject matter; it is no more than a blueprint for a machine. But, like the machine, a *programmed computer* is patentable if the general requirements for patentability are satisfied because it is a new "machine", a machine with a new arrangement of parts which is physically different from all other machines. That new machine is in a class of subject matter which is indisputably statutory subject matter under 35 U.S.C. § 101. And a new method of operating a machine under programmed control is patentable under 35 U.S.C. §§ 100(b) and 101 because it is a new "process".

ARGUMENT

I.

A METHOD OF OPERATING AN ELECTRONIC MACHINE IS THE SAME WHETHER THE METHOD IS UNDER FIXED OR PROGRAMMED CONTROL.

There is no dispute that apparatus for, and methods of, operating machines under fixed control are statutory subject matter, and indeed hundreds of thousands of patents have been issued therefor. Any argument that execution of a machine method under programmed control should not be patentable, as opposed to execution of the same machine method under fixed control, is in error because it necessarily misconceives the true nature of the single invention which is common to both of the embodiments.

The true nature of a machine process invention (under fixed or programmed control) is best appreciated by reference to a hypothetical example which is not clouded by "mathematical" considerations.[1] Assume that a textile manufacturer has developed a new fabric having numerous admirable qualities, but which is so delicate that there is no known way to wash it in a washing machine without tearing it. Assume further that an inventor has discovered a machine process for safely washing the fabric. That process entails a specific and novel sequence of steps including rinsing, spinning, drying, etc., each of which is carried out within a specified temperature and time range.

There are two different ways to control the newly invented sequence of steps for operating the washing machine.

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[1] The irrelevance of "mathematics" as an issue before the Court will be considered in the following section.

One of these requires the mechanical modification of a conventional washing machine. Such a machine includes a set of cams which slowly rotate after the machine is turned on. Each cam has notches in it which operate respective electrical switches as the cam rotates. When a switch is operated, it causes a specific operation to take place (e.g., drying at 100° Fahrenheit). The length of time during which each switch is operated depends upon the length of a notch in the respective cam. Depending on the type of fabric to be washed, a different set of cams can be brought into play by appropriately setting a control knob on the machine. What is required to implement the new machine process is to provide an additional set of cams which can be called upon when the new fabric is to be washed. This type of machine process control is of a "fixed" nature. Although the operator can choose from among different sets of cams, all of the sets are built into the machine, and no machine sequences other than the fixed ones can take place.

The second way to implement the new machine process (along with the old washing cycles) is to use a computer. Instead of providing *any* fixed sets of cams (old or new), a small computer could be programmed to operate the various electrical switches at appropriate times. A different program would control the wash cycle for each different type of fabric. In this case, the new machine process (as well as the old ones) would be under "programmed control".

In determining which of the two implementations of the hypothetical machine process should be patentable, attention should be focused on the underlying invention, that is, what is the new "useful art" under Article 1, Section 8 of the Constitution. The invention is not providing a new set of cams for the conventional washing machine, or appro-

priately programming a computer to control the running of a washing machine in the new way. Rather, it is the new sequence of steps in the washing cycle of the machine—a classical example of a patentable process. *Cochrane* v. *Deener*, 94 U.S. 780 (1876).

What the petitioner seeks from this Court is a ruling to the effect that the Patent Statute recognizes a difference in *how* the machine process is implemented, that is, whether the steps in the washing cycle are governed by fixed or programmed controls. There is no logic in that, nor is there any basis for such a distinction in the Constitution or the Patent Statute. The same requirements for patentability—including those dealing with obviousness as established by this Court in *Graham* v. *John Deere Co.*, 383 U.S. 1 (1965)—should apply to any machine process, regardless of how it is implemented.

When the specific invention of respondents Benson and Tabbot is considered, an initial reaction might be that it is more "mathematical" in nature than washing machine cycles. The role of mathematics in this and similar cases will therefore now be discussed.

II.

THAT AN ELECTRONIC SYSTEM (COMPUTER OR NON-COMPUTER) MAY BE BASED ON MATHEMATICAL RELATIONSHIPS IS IRRELEVANT TO THE ISSUE BEFORE THE COURT.

A. That Any Otherwise Patentable Method Is Based On A Mathematical Relationship Does Not Render It Unpatentable

Thousands of patents have issued on inventions which are based on mathematical relationships. Yet this has never given rise to any serious question concerning patentability. For example, the odometer or mileage indicator in every car "counts" the number of miles travelled. It has never been seriously suggested that this device is non-statutory subject matter.

The use of mathematics pervades present-day technology. Mathematics is so essential to the design of electronic systems that a special algebra has been extensively developed just for this purpose. Indeed, this Court has recognized that "[w]hile a scientific truth or the mathematical expression of it is not patentable invention, a novel and useful structure created with the aid of knowledge of scientific truth may be". *MacKay Radio & Telegraph Co.* v. *Radio Corporation of America*, 306 U.S. 86, 94 (1939).

All of the briefs submitted in support of the petitioner rely on this Court's decision in *Funk Bros. Seed Co.* v. *Kalo Inoculant Co.*, 333 U.S. 127 (1948), for the proposition that a principle or law of nature may not be monopolized. However, the decision in *Funk Brothers* found a lack of patentable invention not because the claimed inoculant was predicated on a law of nature, but rather because the *only*

thing which the inventors did was to discover this law of nature. In *Great A.&P. Tea Co.* v. *Supermarket Equipment Corp.*, 340 U.S. 147 (1950), this Court held that an aggregation, whose whole did not exceed the sum of its parts and which did not provide an unusual result, could not be patented. See also, *Anderson's-Black Rock, Inc.* v. *Pavement Salvage Co.*, 396 U.S. 57 (1969). All the Court held in *Funk Brothers* was that the multiple-strain bacteria inoculant which was in suit was an "aggregation of species [which] fell short of invention within the meaning of the patent statutes". *Id.* at 131. All species in the inoculant had the same individual effects they always had and their use together did not improve in any way their natural functioning. The inoculant patent was held invalid not because the invention was predicated on the discovery that different strains of bacteria were compatible, but rather because the implementation of that discovery was not a patentable "combination".

For an invention to be patentable under *Funk Brothers, A.&P.*, and *Anderson's-Black Rock*, its elements or steps must cooperate in such a way that the whole exceeds the sum of the parts. A machine process invention which includes a series of disjointed and unrelated steps cannot be patented. But a machine process invention whose steps, in combination, cooperate to produce a new result, certainly is within the ambit of statutory subject matter, whether or not the process is based on a scientific or mathematical discovery.

Any patent application which claims a mathematical formula per se should properly be rejected. But the same treatment should not be accorded to a novel *machine process* which happens to be based on mathematical relationships.

Otherwise, patents would not be granted on adding machines, odometers, electric utility meters and a host of present-day more sophisticated products, such as radar and lasers.

B. That the Benson and Tabbot Invention Is Based on a Mathematical Relationship Does Not Render It Unpatentable

The Benson and Tabbot invention as claimed is not a mathematical formula; instead, it is a machine process which is based on a mathematical relationship. Moreover, this machine process can be performed by mechanical equipment such as cams and gears (admittedly statutory subject matter) no less accurately that it can be under programmed control.

Consider the situation in an industrial plant, for example, in which a machine monitors an assembly line and generates electrical signals which represent parameters such as the speed of a conveyor belt, the opening and closing of certain valves, etc. The electrical signals are generated in a particular order and all of the electrical signals must be transmitted to a control room. But the control room is designed to receive electrical signals in a completely different form. What is required is an intermediate machine, and a method of operating it, for converting the generated signals to the form acceptable by the control room.[2] The method must comprise a series of steps, based on a mathematical relationship, to develop one set of electrical signals from another.

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[2] Converters of the type invented by Benson and Tabbot are highly practical and widely used in applications of the type under discussion.

The Benson and Tabbot invention is just such a machine method for converting electrical signals from one form to another.[3] Their method can be implemented under fixed control, much as an odometer converts the number of rotations of a tire to the rotations of gears in a mileage indicator, or it can be implemented under programmed control. Mathematics is as irrelevant to the patentability of the programmed control embodiment as it is (and would be considered by the Patent Office to be) to the patentability of the fixed control embodiment.

III.

A NEWLY PROGRAMMED COMPUTER IS A NEW MACHINE AND IS THEREFORE STATUTORY SUBJECT MATTER.

A written sequence of program instructions is *not* patentable; it is only a writing.[4]

What *is* patentable is the new machine which exists *after a program is stored in a computer*, and the method of operation of that new machine, i.e., the sequence of steps which it performs.

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[3] Any machine process under programmed control entails operations upon electrical input signals and the generation of electrical output signals. Computers operate only upon electrical signals even though for descriptive purposes references may be made to number representations.

[4] While copyright protection is theoretically available for such a writing, this form of protection is of little value because copyright only protects the copying of the writing itself. Copyright is wholly inadequate to protect the method of operation of a programmed machine. See *Baker* v. *Selden*, 101 U.S. 99 (1879). In any event, the availability of other forms of protection for programmable inventions is irrelevant to the issue before the Court.

When a program is first stored in a computer, what happens is that hundreds, thousands, or often even hundreds of thousands of minute component elements in the machine are *physically* changed. Once they are so changed, a new sequence of operation of the machine is established. A new sequence results because there is a *new combination* or arrangement of elements, even though the individual elements are all old. This Court has repeatedly recognized that a new arrangement of old elements, i.e., a new combination, is statutory subject matter:

> ". . . As is usual in combination patents, none of the elements in either of these patents were themselves patentable at the time of the patent, nor are they now. . . . The patents were warranted not by the novelty of their elements but by the novelty of the combination they represented. Invention was recognized because Laitram's assignors combined ordinary elements in an extraordinary way—a novel union of old means was designed to achieve new ends. Thus, for both inventions 'the whole in some way exceed[ed] the sum of its parts.' Great A&P Tea Co. v. Supermarket Equipment Corp., 340 U.S. 147, 152 (1950)." *Deepsouth Packing Co.* v. *Laitram Corp.*, —U.S.—, —, 32 L. Ed.2d 273, 277 (1972.)

The programming of a digital computer similarly results in a new combination to achieve a new end. This engineering fact should be dispositive of the broadened issue which has appeared in this case.[6]

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[6] How the storing of a program in a computer creates a new machine, and the equivalence of machine processes under fixed and programmed controls, are demonstrated in a much more rigorous manner in the Appendix hereto.

IV.

EVEN IF A PROGRAMMED COMPUTER IS CONSIDERED TO BE A NEW USE OF AN OLD MACHINE, THAT IS NOT A BAR TO PATENTABILITY.

On pages 12-13 of its Brief, the petitioner says the following about the Benson and Tabbot invention:

> ". . . No new machinery or hardware is necessary to complete the series of logical or mathematical steps described. The mathematical procedures recited in the claims can be carried out in existing computers long in use; . . ."

But "new machinery" is not a prerequisite of patentability. Almost all electronic systems are combinations of the same basic building blocks. What is required for patentability in almost every case is a *new combination* of building blocks, not new building blocks per se. And when

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[1] (Continued)

That the programming of a computer results in a new machine combination has been recognized by the C.C.P.A., *Application of Bernhart*, 417 F.2d 1395, 1400 (1969). It has also been recognized by the Commissioner of Patents:

> "A programable machine, such as a general purpose computer, with its various parts not interconnected to perform any useful combined operation is merely a 'warehouse' of unrelated parts. It may well be that the same machine, with a program device correctly related thereto, may yield a novel and useful machine combination due to the new interrelation of parts. In other words, the fact that such a prior art machine can have its parts interrelated by a program device in a new way to carry out machine functions of a specialized character may well result in a new patentable combination, unless there is a prior art teaching that would make the interrelations and results thereof obvious." Guidelines of August 2, 1966, 829 Official Gazette 1.

The facts on which this policy of the Commissioner was based have not changed.

a designer causes a digital computer to be programmed in a new way, he places numerous building blocks in a new combination which is no less a patentable combination than is any other system.

Furthermore, while the method claimed in the Benson and Tabbot application could have been carried out in a computer which existed at the time the invention was made, that could have been so only if numerous component elements in that computer were rearranged and placed in a new combination. A general-purpose digital computer is a very fast and flexible machine, but it is wholly dependent on its input instructions. It can do nothing without being told (programmed). Every single step, down to the most trivial detail, must be specified. A computer which existed at the time the Benson and Tabbot invention was made could have carried out the steps of the Benson and Tabbot method *only* if its basic building blocks were arranged in the proper combination. There was no such computer because Benson and Tabbot were the first ones to devise their particular machine process and cause a machine's building blocks to be appropriately arranged to carry out the method. It cannot be suggested seriously that any prior art computer could have performed the method of Benson and Tabbot without knowledge of their invention.

But even without considering the fact that the programming of a digital computer results in a new machine, petitioner's position is still incorrect. Even if all that a programmer invents is a new use of an old machine (implied by petitioner's argument that the Benson and Tabbot procedures could have been carried out in existing computers), the mere fact that the computer could have been made effective to carry out the process is not a bar to patentability.

> "If the mere fact that a prior device might be made effective for the carrying on of a particular process were sufficient to anticipate such process, the absurd result would follow that, if the process consisted merely of manipulation, it would be anticipated by the mere possession of a pair of hands." *Carnegie Steel Co.* v. *Cambria Iron Co.*, 185 U.S. 403, 425 (1902).

In any event, 35 U.S.C. § 100 defines the term "process" as including "a new use of a known . . . machine", and Section 101 states that "[w]hoever invents or discovers any new and useful process, . . . may obtain a patent therefor, . . ." Clearly, it was the Congressional intent to extend protection to the inventor of a new use of an old machine.

The claims in issue define a method of operating a machine, i.e., a digital computer. The machine process is new, and before the inventors' discovery existing machines could not practice it. Benson and Tabbot taught how to physically change an existing machine, i.e., how to rearrange its parts, so that it could practice a new machine process. They found a new use of that machine and they are entitled to a patent for their invention.

V.

THE TWO WAYS OF IMPLEMENTING A MACHINE PROCESS ARE TECHNOLOGICALLY INTERCHANGEABLE AND ARE BECOMING INDISTINGUISHABLE IN PRACTICE; IT IS IMPOSSIBLE TO MAKE A MEANINGFUL LEGAL AND PRACTICAL DISTINCTION BETWEEN THEM.

A "computer program" (or "software"), which is simply a list of instructions, is not patentable. The broadened question before the Court is whether a *programmed* general-purpose computer ("hardware"), i.e., a machine *whose parts are newly rearranged and combined so that it performs a new and novel machine process*, is patentable subject matter,[6] protectible by either conventional apparatus or method claims.[7]

It is important to understand how many electronic systems are designed in the first place. Suppose, for example, that it is desired to build or modify a washing machine to wash delicate fabrics as described above. After the basic machine process is conceived, there are two different approaches which can be taken. In one, a special-purpose con-

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[6] In general, most programmable "inventions" will not be patentable because of obviousness under 35 U.S.C. § 103—a fact conceded by even the most ardent proponents of protection for programmable machine process inventions. However, despite the petitioner's argument that the Benson and Tabbot "theorem follows automatically from the definitions of pure binary, decimal, and BCD numbers . . ." (Petitioner's Brief, p. 15), obviousness is not an issue before the Court in this case.

[7] The arguments in the briefs of the petitioner and its supporters, insofar as they pertain to alternative forms of protection (both existing and contemplated), foreign law and alleged Patent Office search difficulties (despite the fact that numerous "software" patents have been issued), are not relevant to the issue of whether a particular type of invention is embraced by the Patent Statute.

trol mechanism is built which can do only the tasks conceived by the designer. In the washing machine example, this control mechanism would consist of specially shaped cams which would determine the rinse, spin, etc. sequence, and the temperature and time interval ranges. Unfortunately, after such a mechanism is built, it is often found that the machine process does not work precisely enough and the mechanism must be redesigned.

In the other approach, a general-purpose digital computer is used; the computer is programmed so that it controls precisely the same steps as the special-purpose mechanism. One great advantage of using the computer is that it takes considerably less time to devise the necessary program, and, if it does not work with sufficient precision, it is a relatively simple matter to change the program. But in both cases it is the same machine process which is implemented. Often, the inventor pursues both the hardware and software approaches in order to determine which is best.

Operating Systems Survey, 1971, published by Auerbach Publishers, a leading source of data processing reports, gives several examples of the equivalence of hardware and software, from the standpoint of engineering design, and the manner in which particular functions can be accomplished under either fixed or programmed control:

> ". . . In several systems designed primarily for real-time processing (e.g., the XDS Sigma 2/5/7, IBM 1800), this scheduling function is performed by the system *hardware*. Other systems require a *software* scheduling routine to provide this function in lieu of the hardware capability." *Id.* at 96. (Emphasis added.)

> "When storage is divided into pages . . ., the program loading function may consist of simply loading all of the required main storage pages, or it may entail preparing the system for a process called paging. . . . In many systems this . . . is accomplished through *hardware* circuitry. In others, it must be accomplished via *software*." *Id.* at 102-103. (Emphasis added.)

The critical issue should always be whether a combination of steps performed by a machine is obvious, not which type of machine (a programmed computer or a special-purpose fixed mechanism) controls those steps.

While the various briefs have drawn a sharp distinction between hardware and software, the dividing line is not really clear. The engineering profession is coming to

> ". . . view a whole system as a coherent hierarchy of concepts in which there is no one broad line separating software from hardware. . . ." [8]

If the Court attempts to distinguish between hardware and software in allocating patent protection, it must first find that elusive line.

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[8] *Computer*, March/April 1972, page 17, published by The Computer Society of the Institute of Electrical and Electronic Engineers.

VI.

PERHAPS THE COURT SHOULD REQUIRE AN EXPLICIT MACHINE LIMITATION IN CLAIM 13.

The implementation of the machine processes discussed herein requires the sequential execution of multiple instructions. However, little has been said about any individual instruction. But an individual instruction is worthy of consideration because it is really a self-contained program.

A typical instruction might be to add the number contained in one memory location to the number contained in a second memory location, and to store the sum in a third memory location. A computer which executes an "add" instruction of this type is performing a machine process under programmed control.

Yet thousands of patents have been issued by the Patent Office on computers and the individual instruction processes which they perform under programmed control. Most of these patents are owned by the computer companies which have aligned themselves with the Patent Office in this case. Surely, neither the Patent Office nor the machine manufacturers would argue that all machine processes under programmed control should not be patentable, because that would necessarily invalidate thousands of the manufacturers' own "hardware" patents. Yet the single-instruction machine process is no less "mathematical" or "mental" in character than a machine process which requires the execution of several instructions in sequence.

The more limited single-instruction machine process is conceded by all concerned to be statutory subject matter—

provided that it is *claimed* as being performed by a machine. Anything that a computer can do can be done (more slowly) by a human being. But that does not preclude protection if the process claims are limited to performance by or on machines.

Processes, such as that of Benson and Tabbot, which require the sequential execution of multiple instructions are no more and no less statutory, provided that such processes are also limited to performance by machines. Claim 13 before the Court does not explicitly recite that its defined method is to be carried out on a computer. Instead, claim 13 defines operations on "number representations". However, the court below held[9] the claim to be limited to use of the method on a digital computer because the only "practical value" of the method is when it is practiced by a machine.

While this reasoning is sound, perhaps there is some merit in requiring an explicit recitation in the claim to limit the practice of the process to a machine. For example, the preamble of the claim could be revised to state: "A method for use by a data processor to convert. . . ." While the Court may deem this kind of explicit limitation to be desirable, it need not and should not make the unnecessary finding that the numerical conversion method, when properly claimed to be practiced under the programmed control of a machine, is non-statutory subject matter.[10]

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[9] *Application of Benson & Tabbot*, 441 F.2d 682, 687 (1971).

[10] On pages 7-9 of the Brief submitted by *amicus curiae* Honeywell, an explanation of the Pythagorean Theorem is presented together with a claim which defines "the method of determining the hypotenuse of a triangle". The question is asked whether "a novel set of instructions for the mathematical manipulation of Pythagoras' equation . . . is susceptible to patenting".

CONCLUSION

A machine process has long been recognized as statutory subject matter. Until as recently as perhaps twenty-five years ago, a new machine process could be implemented only by building a machine expressly for controlling that process. The same is still true. While it may be easier to program a computer than to build an entire new machine, when that computer is programmed it becomes a new machine by virtue of the *physical* changes which take place in it and the rearrangement of its parts, and it can perform only that process determined by its programmed control. A programmed computer is thus in the same statutory class

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[10] (Continued)
It is difficult to consider this example objectively because all of us have probably used the theorem, and it appears absurd to allow anyone to monopolize any application of such a basic principle. But if the example is to be considered, we must try to assume that the theorem was not known and has just been discovered.
Despite the brilliance of the discovery, its use should be capable of only limited monopolization. Suppose the discoverer builds a machine which allows two dials to be set so as to represent the lengths of the two sides of a triangle, whereupon the machine prints out the length of the hypotenuse. This is precisely the kind of electronic instrument which has long been protectible and on which untold thousands of patents have been granted. See e.g., the Appendix. The hypotenuse-determining machine is clearly based on a mathematical relationship, but if it is not an obvious design—because the theorem has only just been discovered—there is no reason to deny protection on the machine and the method which it practices.
However, the Honeywell hypothetical claim (Honeywell Brief, p. 9) is not explicitly limited to the *machine* practice of the claimed method. If a machine-practice limitation is not impliedly read into the claim, it should be rejected. But if an appropriate limitation is expressly included in the claim, it should be allowable. If such a claim were to be found non-statutory, most electronic patents would be invalid because they too are based on underlying mathematical relationships and the fact that these relationships were new would be irrelevant.

as any other machine, and the method of operating a machine under programmed control (i.e., the sequence of steps which it performs) is in the same statutory class as a method of operating a machine under fixed control. In every case, it is the machine process which should be scrutinized for novelty; whether that process is under fixed control or under programmed control should make no difference in law because it makes none in practice.[11]

As for mathematics, mathematical formulas are not patentable. But inventions which are based on mathematical relationships are susceptible of protection, as recognized by this Court. See, e.g., *MacKay Radio & Telegraph Co.* v. *Radio Corporation of America, supra.*

The hundreds of software companies in this country will be in no position to compete with the machine manufacturers if the latter are allowed to freely copy program inventions; in fact, the machine manufacturers conceivably could "give away" the program inventions of others to induce sales of their computers, just as they now freely distribute some of their own programs. A decision of this Court on the broad question before it will either give life to hundreds of small companies or it will add, in effect, a software monopoly to the hardware monopoly already enjoyed by the machine manufacturers. The question is whether a few select companies will be given a multi-billion dollar monopoly, as opposed to permitting numerous smaller companies to participate in the economic life of this country. This case presents the Court with an opportunity to ensure that the patent system fulfills two of its most significant goals—to stimulate scientific research and to foster competition.

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[11] The reasons for selecting one approach rather than the other are nearly always economic.

Benson and Tabbot would have been given protection as a matter of course had they built a gear-and-cam machine for implementing the same machine process which they implemented on a computer. In requesting the denial of patent protection to Benson and Tabbot, petitioner seeks to penalize them for not having ignored the technological revolution of the past twenty-five years.

Instinet urges that the decision below be affirmed. But even if it is not, e.g., because of a possible deficiency in claim 13, the Court should not unnecessarily broaden its holding to deny protection to any other machine process under programmed control. To do so would prevent the patent system from reflecting technological reality.

Respectfully submitted,

MICHAEL I. RACKMAN
9 East 40th Street
New York, N. Y. 10016
Attorney for Amicus Curiae
Institutional Networks Corporation

Of Counsel:

GOTTLIEB, RACKMAN & REISMAN
JAMES REISMAN

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APPENDIX

A COMPARISON OF TWO ILLUSTRATIVE ELECTRONIC SYSTEMS DEMONSTRATES THE EQUIVALENCE OF CONCEDEDLY STATUTORY ELECTRONIC SYSTEMS AND ALLEGEDLY NON-STATUTORY PROGRAMMED COMPUTERS.

It is the purpose of this Appendix to demonstrate from a technological standpoint how totally illogical it would be to deny protection to machine processes under programmed control, while at the same time affording the traditional protection to the same machine processes under fixed control. Toward this end, two electronic systems will be considered. The first is a fixed control machine whose method of operation is based on a mathematical relationship. While it is not patentable because of "obviousness", it is in a class which is unquestionably subject to patent protection—as evidenced by thousands of patents which have been issued on comparable machines using the same building block elements. The second system is a programmed computer which utilizes no building blocks other than those used in the first system, and which performs the same method, in the same way. It will be evident that both systems are essentially the same, and that no rational distinction can be drawn between them.

In order that the example not be overly complicated, we have selected two simple systems, neither of which can be patented because of obviousness. But what is important is the class of subject matter which the example represents, not whether the two systems themselves are obvious.

The two electronic systems are shown together on the foldout page at the end of this Brief so that the two drawings can be in continuous view as the following description

is read. (The two systems are identical except for those elements shown in bold outlines.)

Before describing the two systems, it will be helpful to consider five basic building-block elements used in electronic systems:

(1) Magnetic core—a miniature doughnut-shaped magnet that is magnetized in one of two ways, i.e., clockwise or counter-clockwise. These two directions are conventionally represented by the two digits 1 and 0 of the binary number system.

(2) Flip-Flop—two transistors connected so that only one of them is turned on at any time (universally represented by the binary digits 1 and 0). The "state" of the flip-flop is switched from a 1 to a 0, or vice versa, by turning off the previously on transistor, and turning on the previously off transistor.

(3) Adder—a device having two sets of input conductors, the electrical signals on which represent two numbers, and one set of output conductors, the electrical signals on which represent the sum of the two input numbers.

(4) Counter—a device whose electrical outputs represent a number, the number being increased by 1 each time another electrical pulse is applied to its input.

(5) Decoder—a device which, for example, might have 4 outputs, with a different output being energized for each of 4 possible input signals.

The electronic system of FIG. 1 is designed to alternately add and subtract successive numbers. The four numbers

are stored in memory 20.[1] The memory can be thought of as a series of cubbyholes each having a number stored in it. Each storage location (cubbyhole) consists of eight magnetic cores, some magnetized in the clockwise direction and some magnetized in the counter-clockwise direction. As mentioned above, for the sake of convenience, the directions of magnetization are represented by the digit symbols 1 and 0 respectively, and each group of eight digits represents a "number". An "address" is associated with each storage location; for the system to retrieve a particular stored number, it must first identify the address of the storage location which contains that number. Memory 20 is shown as having four storage locations with respective addresses 1 through 4. For example, storage location 4 contains the binary number 11010101 (which is equivalent to the decimal number 213). Information is introduced into the memory by memory input unit 38. The input unit can be a keyboard, a magnetic or paper tape reader, etc. Whatever the form of the input unit, it functions to insert four binary numbers into four successive memory addresses. This is accomplished by physically changing the directions of magnetization of 32 magnetic cores.

At regular intervals, "clock" 26 emits successive timing pulses which are applied to the input of counter 24. (The counter and the other circuits are represented by boxes, as they have been in thousands of issued patents, since their inner workings are well known.) The counter develops electrical output signals which represent the number of

[1] As is the practice in filing patent applications on electronic systems, every block of equipment is identified by a reference numeral.

clock pulses applied to its input, i.e., it "counts" the pulses for the purpose of identifying successive memory addresses. Electrical signals corresponding to the number counted by the counter are applied to the input of decoder 22. Depending on which of the address identifying numbers 1 through 4 is represented in the counter, the decoder energizes one of its four output conductors to select a respective address or location in the memory. When a particular location has been selected, the number stored at that address is transmitted over cable 36 to one input of "arithmetic unit" 30. The operation of the arithmetic unit will be described below.

When the first clock pulse causes counter 24 to generate the number 1, the binary number 01011101 stored at address 1 in the memory is transferred over cable 36 to the arithmetic unit. The second clock pulse causes the counter to generate the number 2, and thus the binary number 01101111 stored at address 2 of the memory is transferred over cable 36 to the arithmetic unit. As four successive pulses are generated by the clock, the four successive numbers stored in the memory are sent over cable 36 to the arithmetic unit. (Of course, by the transfer of numbers is meant the transmission of coded electrical signals over cable 36.)

Register 32 is basically another storage location containing a binary number. It is connected via cable 34 to the second input of arithmetic unit 30.

The arithmetic unit is designed to perform a "mathematical" operation on the two numbers applied to its inputs —either addition or subtraction, depending upon which of

the two upper control terminals of the arithmetic unit is energized. Whenever the two numbers at the inputs of the arithmetic unit are added to or subtracted from each other, the resulting sum or difference is entered into register 32 and stored there for later use. This new sum or difference in the register will be used as the second input to the arithmetic unit when the next clock pulse is generated and another number stored in the memory is transferred over cable 36 to the first input of the arithmetic unit.

Clock pulses, in addition to being applied to the input of counter 24, are also applied to the input of flip-flop 28. The flop-flop has two outputs X and Y, and only one of them is energized at any one time. Each clock pulse switches the state of the flip-flop; the first clock pulse causes the flip-flop to energize its output X, the second clock pulse causes the flip-flop to energize its output Y, the third clock pulse causes the flip-flop to energize its output X once again, etc. The X output of the flip-flop is connected to the terminal of the arithmetic unit which controls addition. Therefore, each of the first and third clock pulses causes the arithmetic unit to function as an adder. The Y output of the flip-flop is connected to the terminal of the arithmetic unit which controls subtraction, and therefore each of the second and fourth clock pulses causes the arithmetic unit to function as a subtractor.

As an example of the operation of the system, it is convenient to consider numbers in decimal form (i.e., the ten-digit system in common use). Suppose that register 32 initially contains a 0, and that memory input unit 38 initially stores the decimal numbers 40, 11, 4 and 7 in respec-

tive memory addresses 1 through 4. When the first clock pulse is generated, the number 40 in address 1 of the memory is transferred to the arithmetic unit. The arithmetic unit adds the number 40 to the number 0 in register 32, and then stores the sum 40 in the register. When the second clock pulse is generated, the number 11 in address 2 of the memory is transferred to the arithmetic unit. The arithmetic unit now functions as a subtractor, and subtracts the number 11 from the number 40 which is now in the register. The resulting difference 29 is then stored in the register. The third clock pulse causes the number 4 in address 3 of the memory to be transferred to the arithmetic unit, which now functions as an adder again to add the number 4 to the number 29 contained in the register, and to store the sum 33 back in the register. The fourth and last clock pulse causes the number 7 in location 4 of the memory to be transferred to the arithmetic unit, which now functions to subtract the number 7 from the number 33 in the register, and to store the final difference 26 in the register.

After the fourth cycle of operation, the final "answer" 26 is contained in the register. At this time, the final number can be transferred to output unit 40 which, for example, might be a typewriter which types the number 26. The memory input unit 38 might then receive another set of four numbers for storage in the memory, following which the same sequence of operations takes place with the second "answer" ultimately being printed by output unit 40.

The system of FIG. 2 operates in much the same way, but it is different from the system of FIG. 1 in two respects. First, instead of each memory location containing only 8

magnetic cores, it contains 9 magnetic cores. The extra digit depicted (within the bold outline) in each "row" of the memory is a "code" digit which indicates whether the associated number in the same memory address is to be used in an addition operation or a subtraction operation. The code digit 0 represents an addition operation, and the code digit 1 represents a subtraction operation. The memory input unit, when it first stores in the memory the four numbers to be processed, also stores in each memory address in FIG. 2 one of the two codes 0 and 1, each of which indicates whether the respective associated number is to be added to or subtracted from the number contained in register 32.

It will be recalled that flip-flop 28 in the system of FIG. 1 functions to control alternate addition and subtraction operations. Because each number in the memory of FIG. 2 now has associated with it a code digit which represents the type of operation to be performed on that number, the flip-flop is no longer necessary. Instead, a second decoder 42 is employed. Whenever decoder 22 selects one of the four memory locations causing the 8-digit number stored in that location to be transferred over cable 36 to the arithmetic unit, the code digit in the same memory address is transferred over cable 44 to decoder 42. Decoder 42 has two outputs which are labelled 0 and 1. If the code digit 0 is transferred to the decoder, the decoder energizes its 0 output conductor which is connected to the add control terminal of the arithmetic unit. This causes the arithmetic unit to function as an adder. Conversely, when the code digit 1 is transferred to decoder 42, the decoder energizes

its 1 output conductor. This output, connected to the subtract control terminal of the arithmetic unit, when energized, causes the arithmetic unit to function as a subtractor.

Since the code digits at addresses 1 through 4 alternate (0, 1, 0, 1), it is apparent that the arithmetic unit functions alternately as an adder and as a subtractor, and that the system of FIG. 2 does precisely the same data processing operations as does the system of FIG. 1, leading to the same "answer" being printed by output unit 40 of FIG. 2.

The system of FIG. 1 typifies the kind of fixed control electronic system which is disclosed in hundreds of thousands of issued patents. It is unquestionably statutory subject matter.

The system of Fig. 2 is a general-purpose digital computer[3] after it has been programmed, that is, after 4 mag-

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[3] This can be confirmed by making reference to the following definition submitted by petitioner on pages 6-7 of its Brief. The added bracketed material in the following quotation demonstrates how the system of FIG. 2 satisfies the definition:

> The basic parts of a digital computer are its (1) input [memory input unit 38], (2) storage unit [memory 20 and register 32, since as described above the register may be nothing more than a fifth memory location], (3) arithmetic and logic unit [arithmetic unit 30], (4) control unit [clock 26, counter 24 and decoders 22 and 42], and (5) output [output unit 40]. Data and instructions are inserted into the computer at the input [8-bit data and 1-bit instructions are inserted into the computer by memory input unit 38]. The storage unit receives data, and holds it for subsequent use or retrieval [memory 20 is the storage unit which receives the data to be operated upon, and holds it for subsequent use when it is retrieved by the arithmetic unit]. The arithmetic and logic unit consists of various circuits for performing multiplication, division, and other arithmetical or logical operations [arithmetic unit 30 performs addition and subtraction operations]. The control unit includes the circuits that effect selection and retrieval of instructions from storage or

netic cores have been physically changed so that their magnetizations alternate in direction to give rise to a new combination. The system is in a statutory class because it utilizes *precisely the same elements* used in the unquestionably patentable type of electronic system shown in FIG. 1. Each memory address in the computer of FIG. 2 contains nine magnetic cores rather than eight, and it contains two decoders (22 and 42) rather than only one. But its basic building blocks are no different from those which for years have qualified for patent protection in system configurations. The system of FIG. 2 is the more flexible one because the user has the option of storing different codes in the memory (physically changing it) so that the sequence of operations can be varied.[3] But once a particular set of code digits is stored in the memory along with the numbers to be processed, the final system performs a machine process which is *identical* to that of the system of FIG. 1. Since the general-purpose digital computer of FIG.

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from outside the computer [the control unit elements select and retrieve 1-bit instructions in the memory], in proper sequence [the instructions are selected in the proper sequence because counter 24 identifies successively numbered memory locations], and the carrying out of each of the coded instructions by generation and application of proper signals to the appropriate units [the coded instructions are carried out by the application by decoder 42 of the proper signals to the two control inputs of the arithmetic unit].

[3] There are 16 different sequences of code digits which can be stored in the memory of FIG. 2, and thus the user can select any one of 16 sequences of operations to be performed, e.g., first-subtraction, second-subtraction, third-addition, and fourth-subtraction. A commercial computer, of course, has a much larger memory, longer code digit sequences, and can execute many different types of instructions. Nevertheless, the system of FIG. 2 is unquestionably a digital computer.

2, *after it is programmed* with 0 and 1 "instruction" code digits, does precisely the same thing as the conventional type of fixed control electronic system shown in FIG. 1, and in the same way, and with the same elements, there is certainly no valid or reasonable basis for one system (FIG. 1) to be considered statutory subject matter, and the other (FIG. 2) not.

FIG. 1

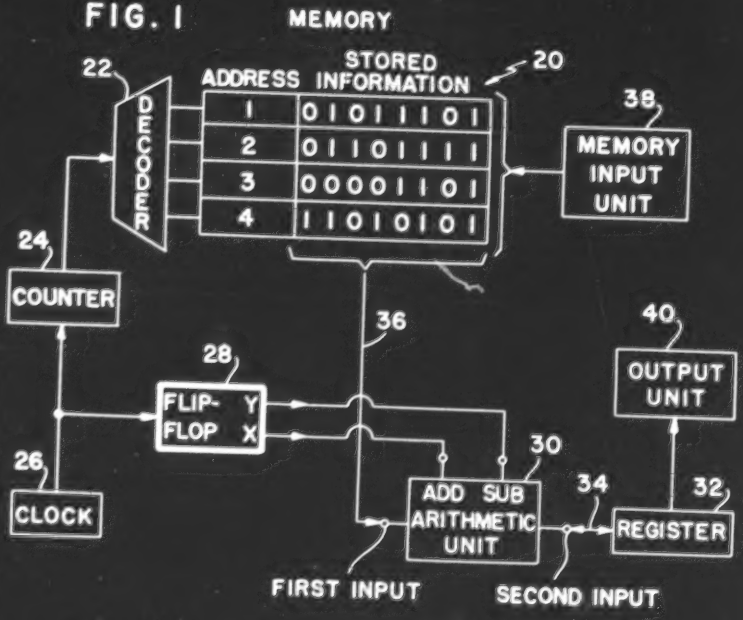
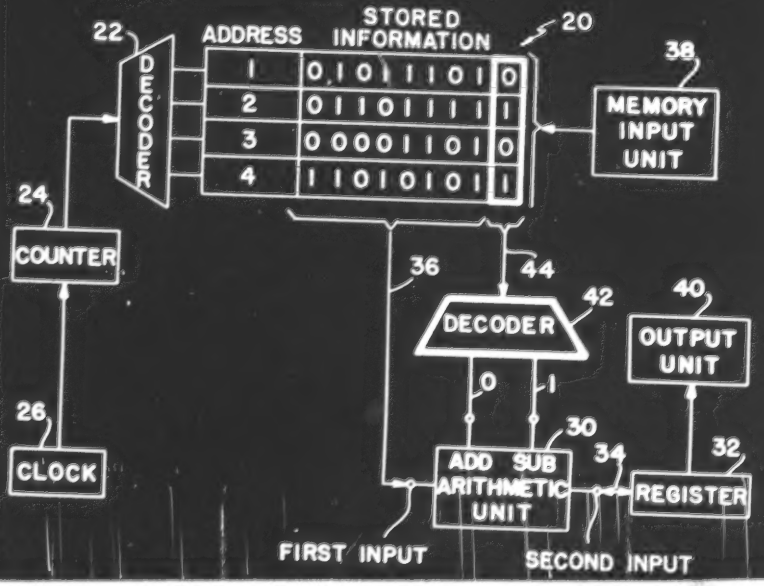

MEMORY
STORED
ADDRESS INFORMATION
20
22
DECODER
1 0 1 0 1 1 1 0
2 0 1 1 0 1 1 1 1
3 0 0 0 0 1 1 0 1
4 1 1 0 1 0 1 0 1
38
MEMORY
INPUT
UNIT
24
COUNTER
36
40
OUTPUT
UNIT
28
FLIP- Y
FLOP X
30
26
CLOCK
ADD SUB
ARITHMETIC
UNIT
34
32
REGISTER
FIRST INPUT
SECOND INPUT

FIG. 2


MEMORY
STORED
ADDRESS INFORMATION
20
22
DECODER
1 0 1 0 1 1 0 1 0
2 0 1 1 0 1 1 1 1
3 0 0 0 0 1 1 0 1 0
4 1 1 0 1 0 1 0 1 1
38
MEMORY
INPUT
UNIT
24
COUNTER
36
44
42
DECODER
40
OUTPUT
UNIT
0
1
26
CLOCK
30
ADD SUB
ARITHMETIC
UNIT
34
32
REGISTER
FIRST INPUT
SECOND INPUT